Corn Seed Treatment Dust: Exposure and Effects on Honey Bees in Ohio

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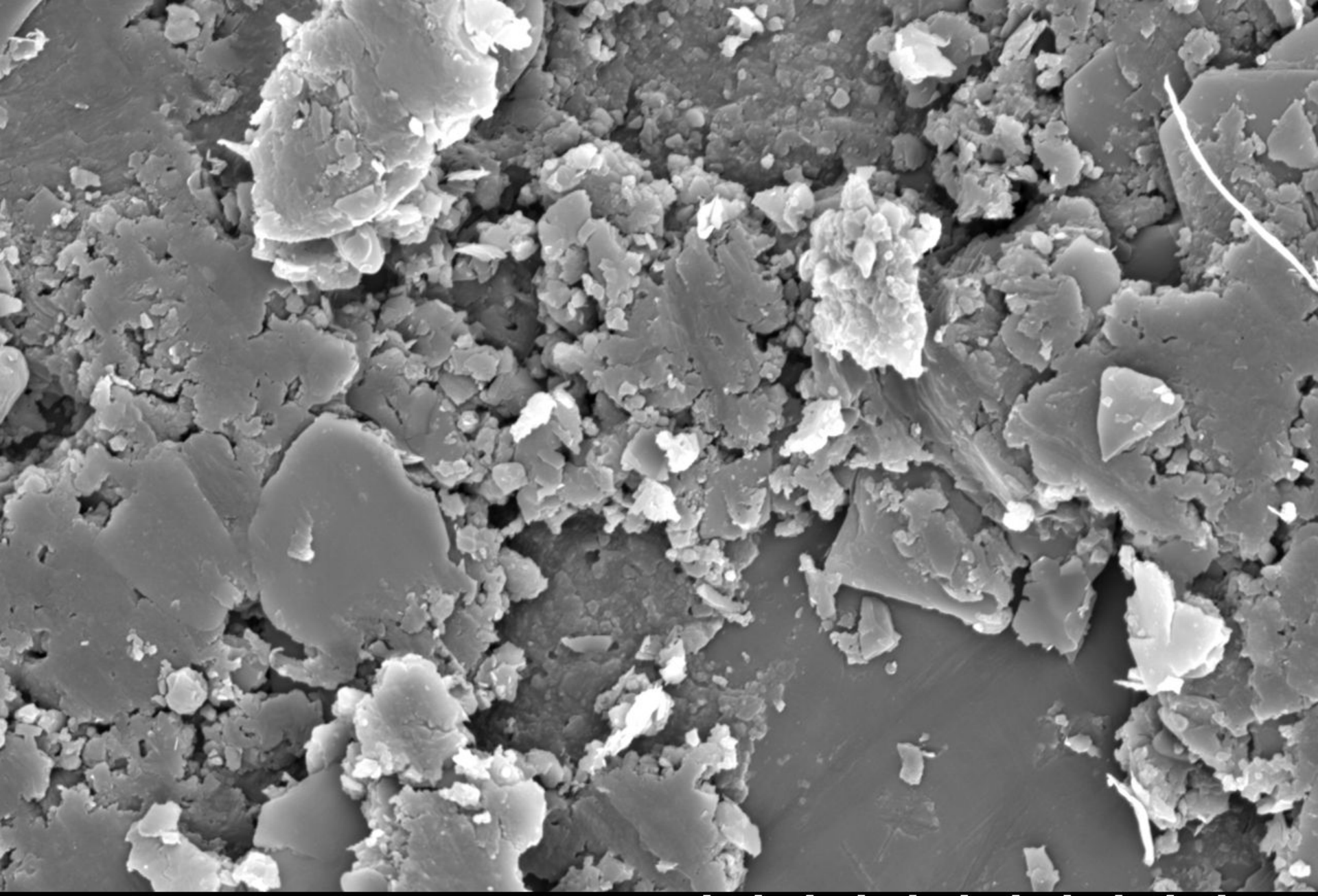

SE 22-Apr-15 WD27.9mm 15.0kV x1.0k 50um

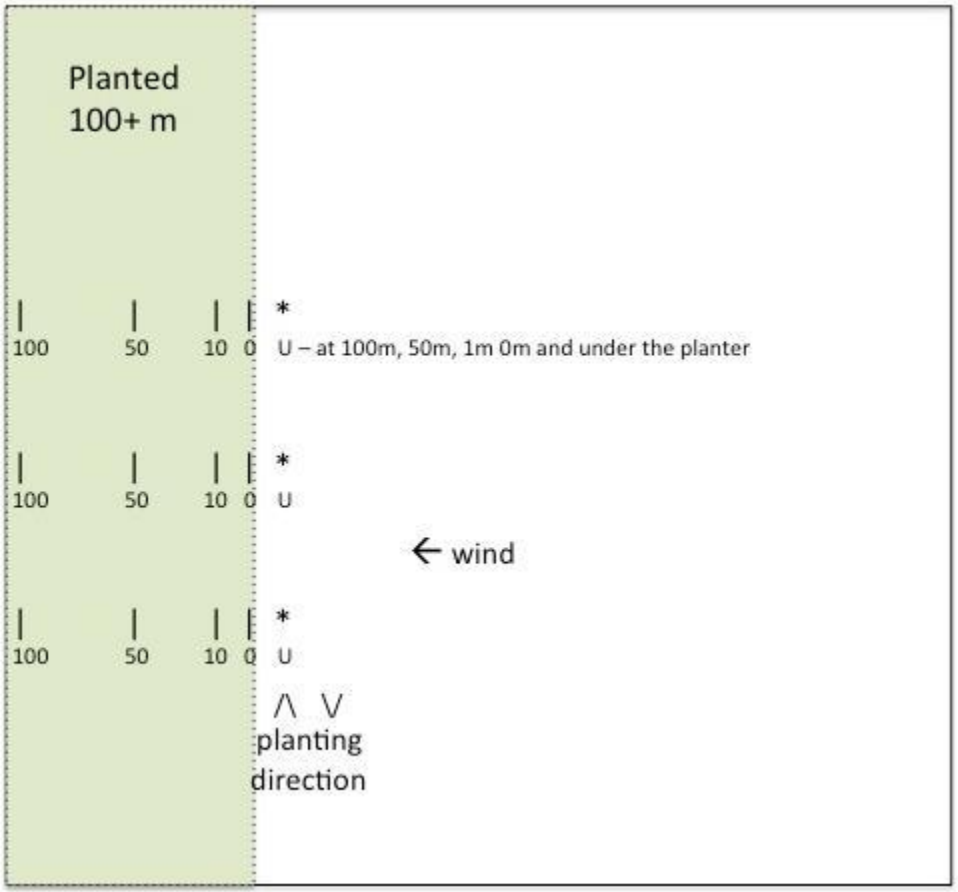
Dekalb hybrid DKC62-97RIB with Clothianidin 500 from the Acceleron treatment

http://seedworld.com/seed-treatment-saga/

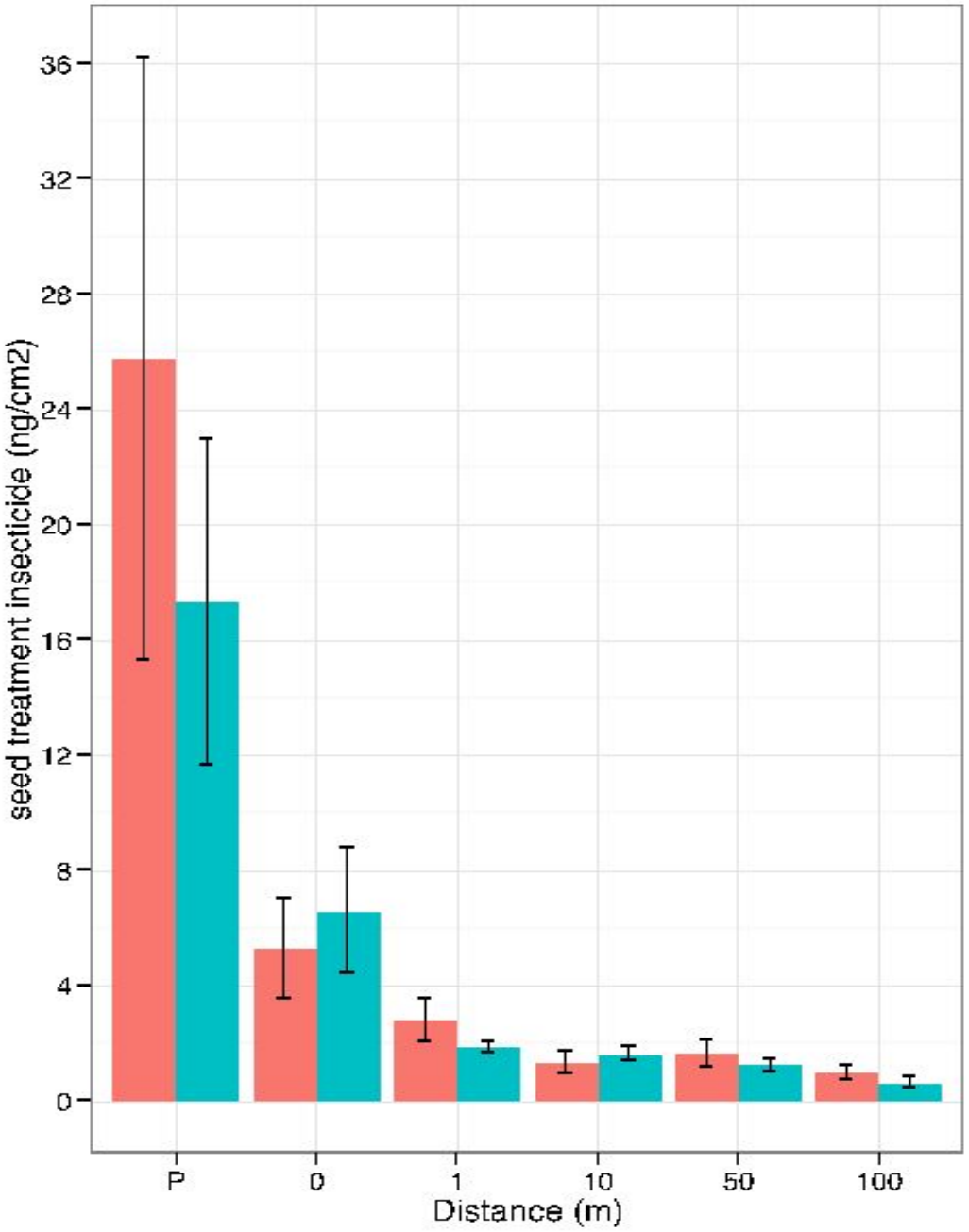
Measure Dust Drift

Krupke-style dust detectors

Harold Watters,
Ohio State Extension



Comparison of seed lubricants 2014



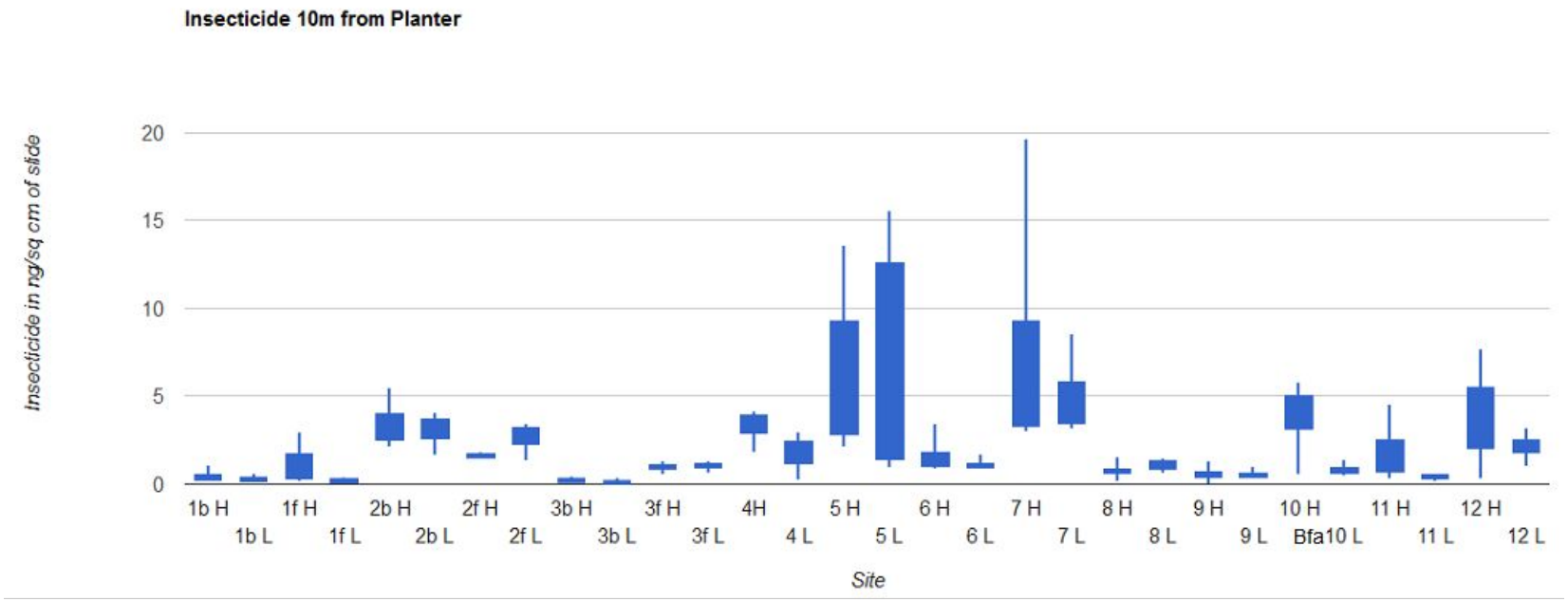
Seed Lubricant

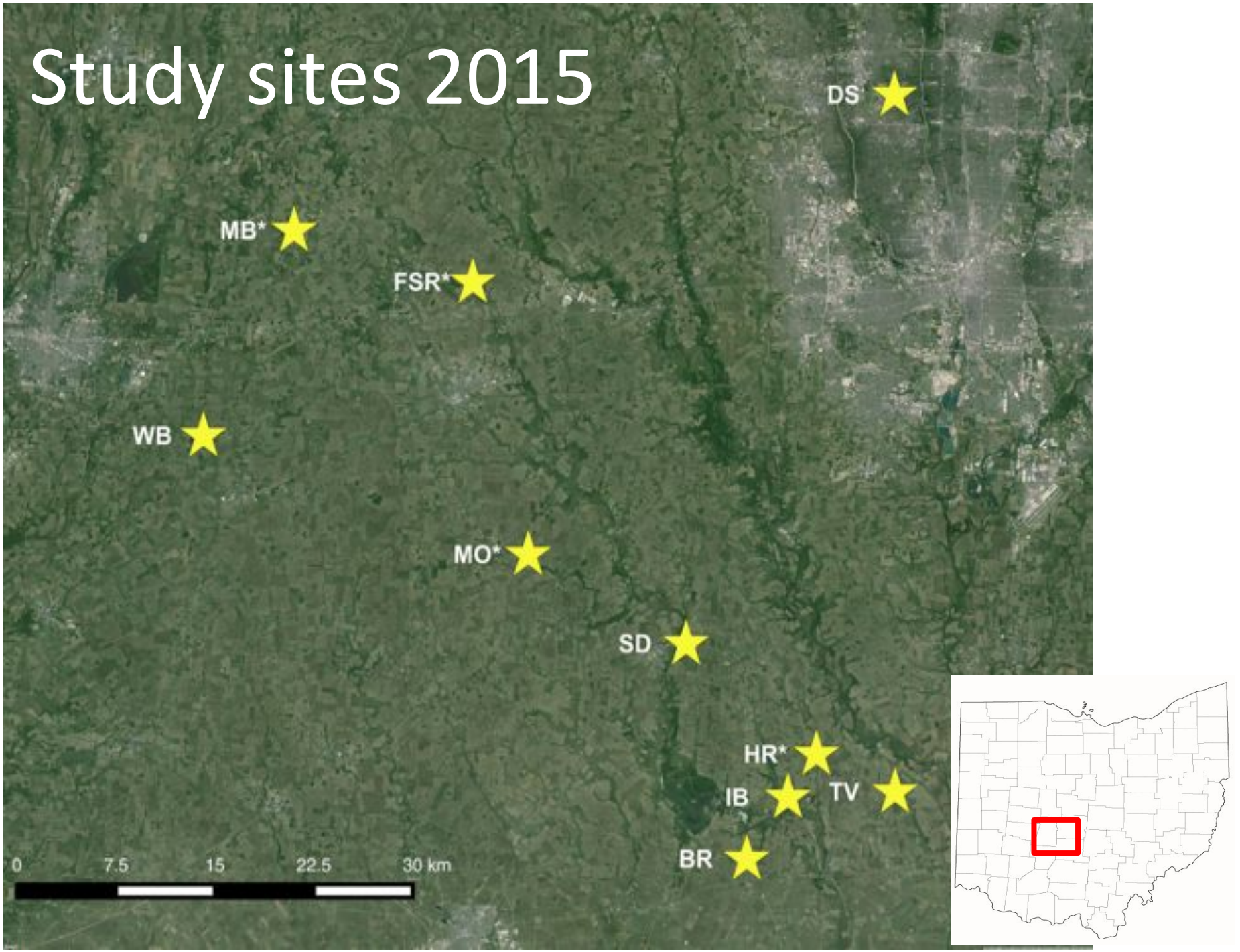
Bayer Fluency Agent

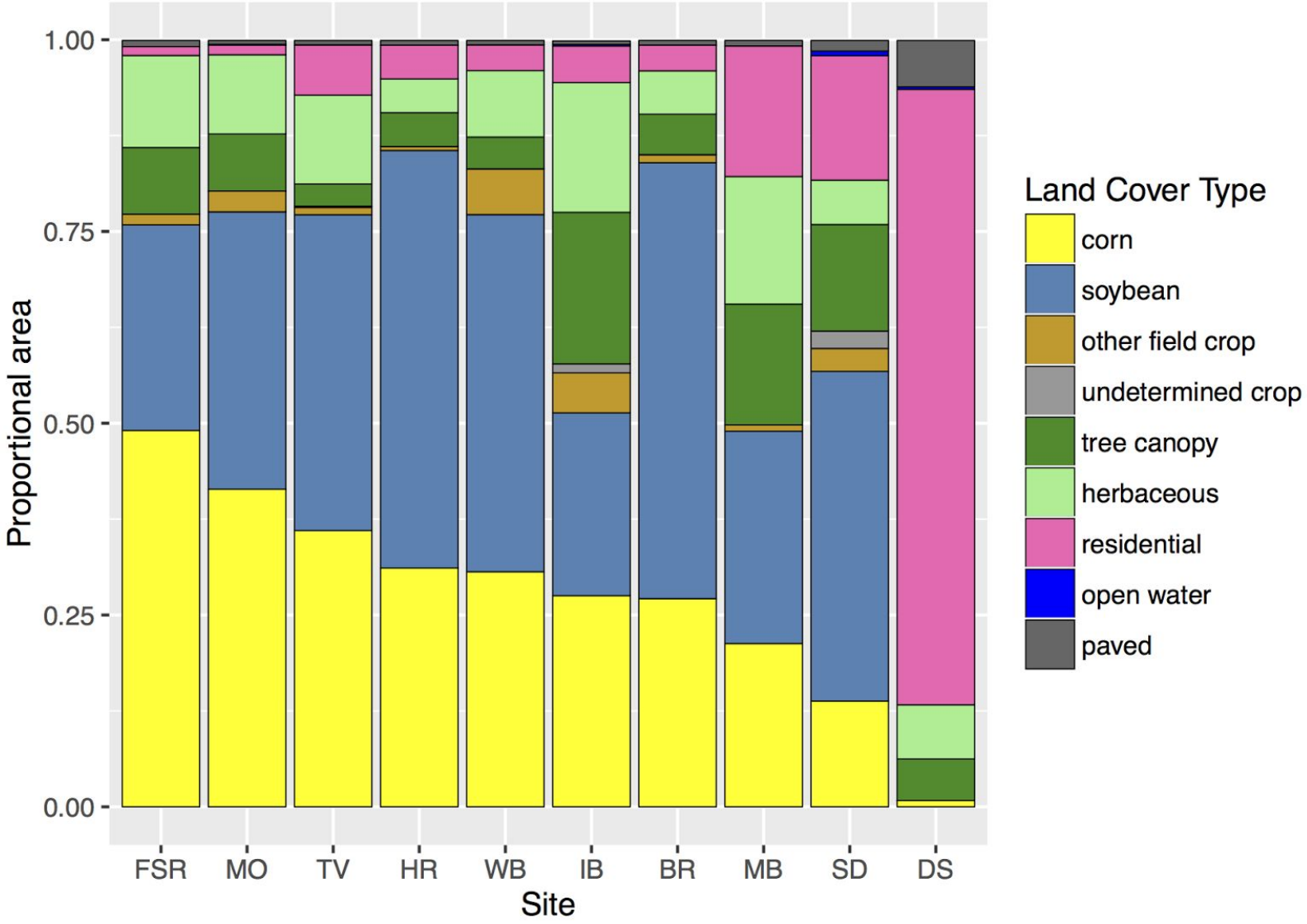
Farmer's Choice

N=7

Dust emission is highly variable

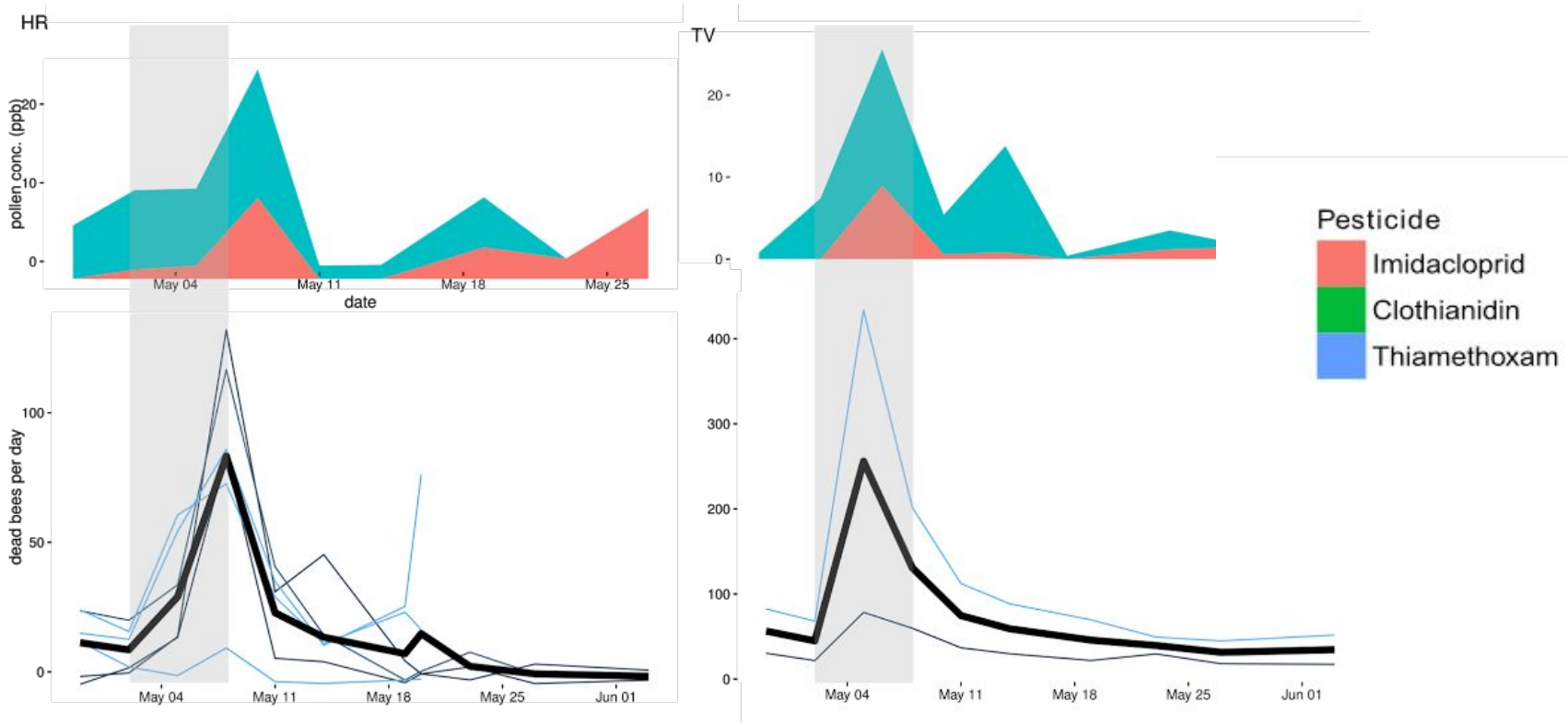



Study sites 2015
DS
MB*
FSR*
WB
MO*
SD
HR*
IB
TV
BR
0
7.5
15
22.5
30 km


1.00
0.75
0.50
0.25
0.00
Proportional area
FSR
MO
TV
HR
WB
IB
BR
MB
SD
DS
Site
Land Cover Type
corn
soybean
other field crop
undetermined crop
tree canopy
herbaceous
residential
open water
paved

Collect pollen using a pollen trap

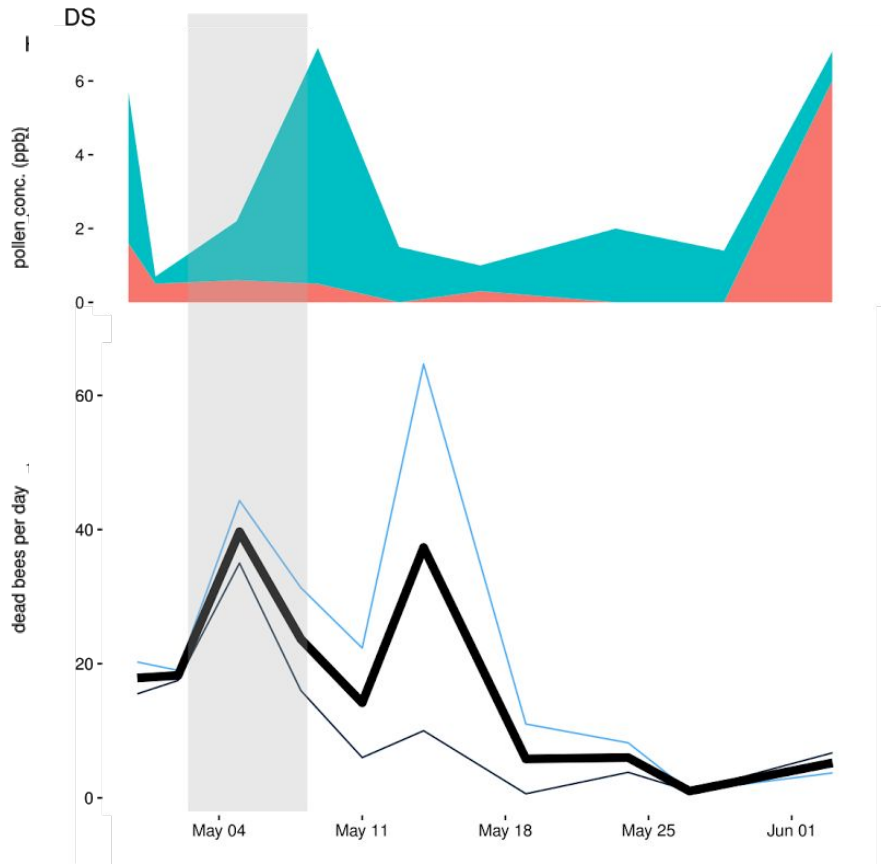

Use “Drop Zone Dead Bee Traps”
to collect dead bees



More seed treatment insecticide was detected in pollen during corn planting (19.6 ppb more; Welch's T-Test, df=30.79, p=0.0004)

More dead bees appeared in dead bee traps during corn planting (2.3-fold more (95% CI=2.0 - 2.8); Two-sample T-test, t=10.29, df=18, p-value < 0.0001)

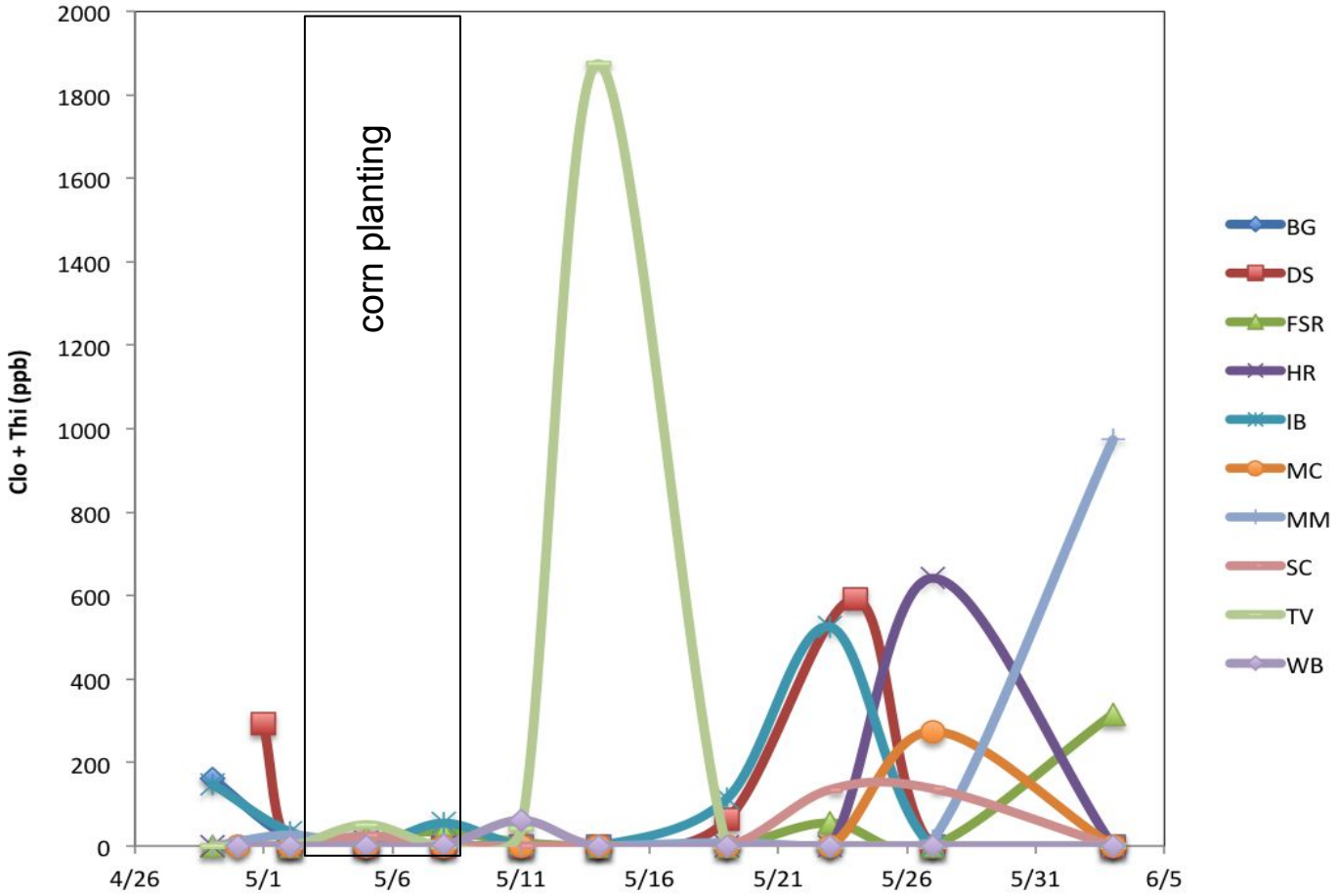
Seed treatment insecticides are low but detectable with <1% corn in area

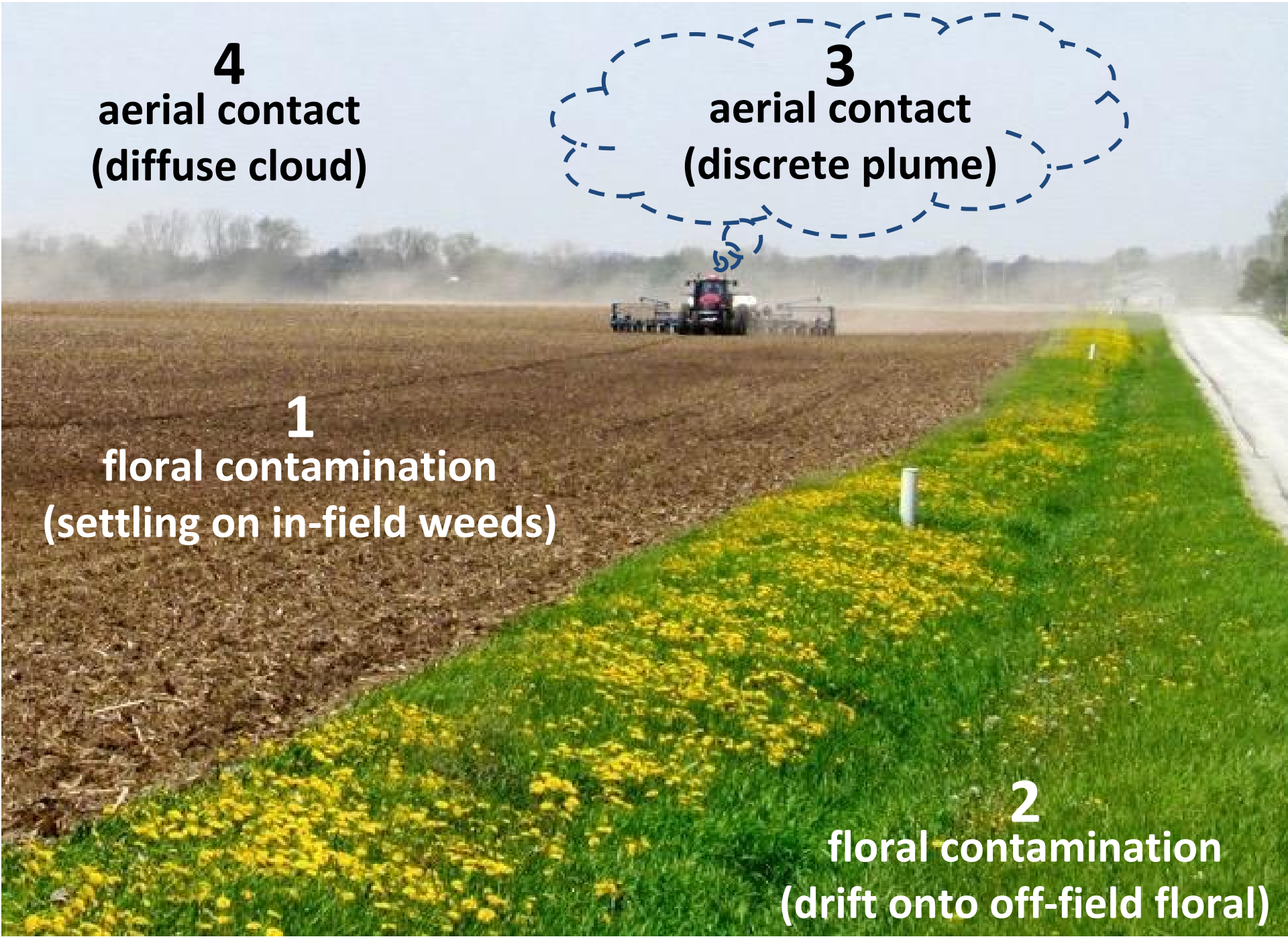


Pesticide
Imidacloprid
Clothianidin
Thiamethoxam

Insecticide in dead bees from traps

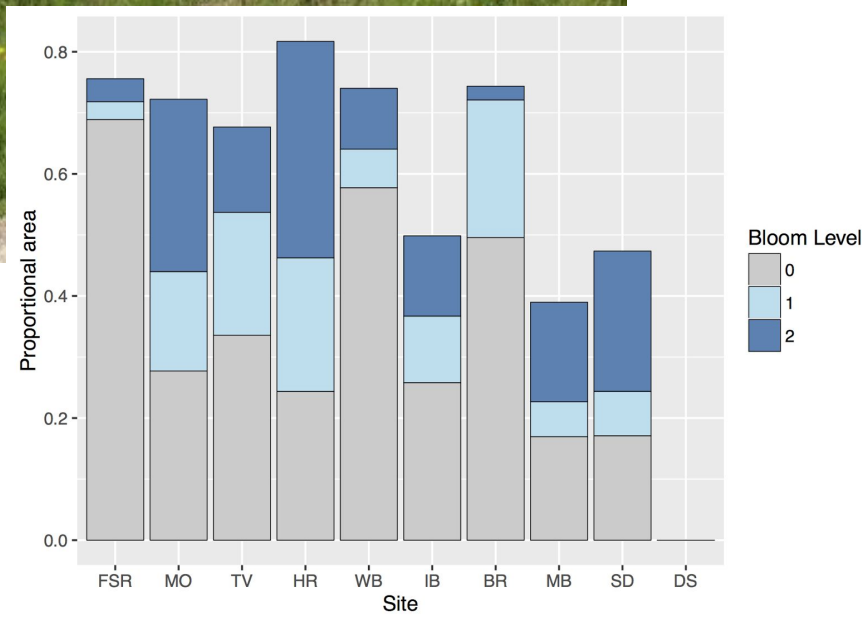
- Highly variable, with higher concentrations outside peak planting period?




4
aerial contact
(diffuse cloud)
3
aerial contact
(discrete plume)
1
floral contamination
(settling on in-field weeds)
2
floral contamination
(drift onto off-field floral)

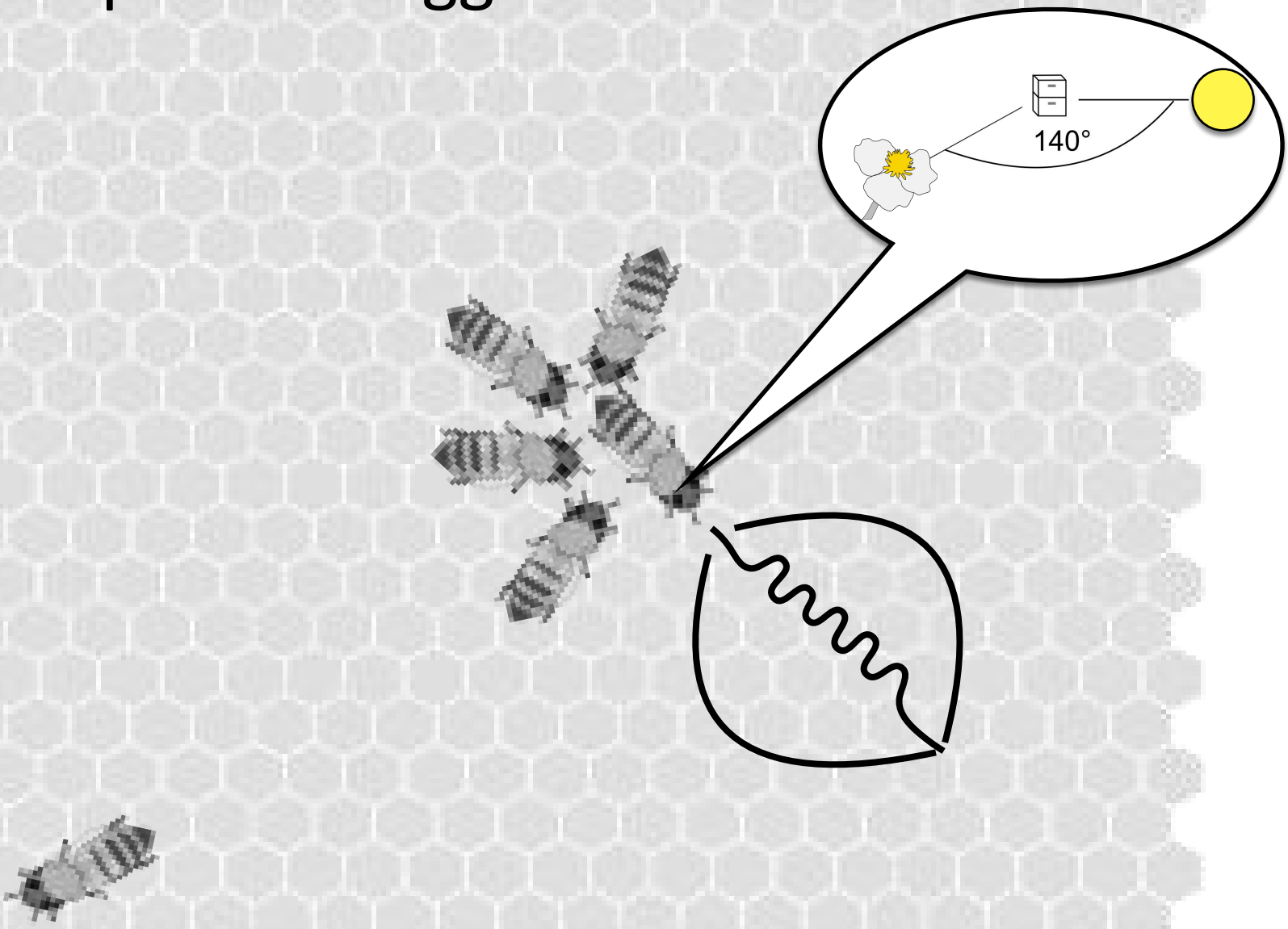
Statistical models testing hypothesized routes of exposure by relating landscape variables to exposure and effects

Main route	Subroute	Statistical model
Floral contamination	In-field settling	Y ~ weedy corn field risk
	Off-field drift	Y ~ drift zone risk
Aerial contact	Discrete plume	Y ~ corn risk
	Diffuse cloud	Y ~ total corn

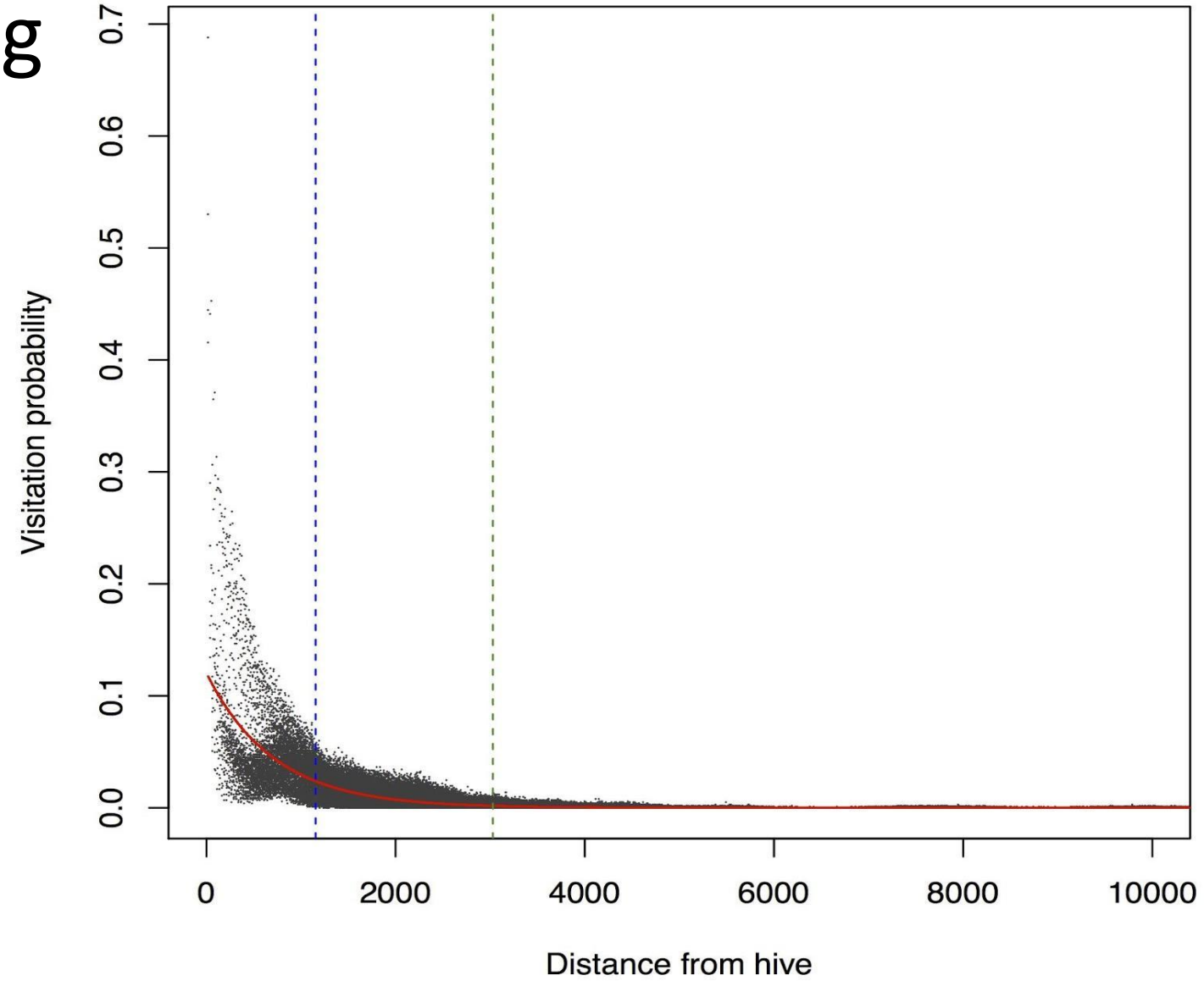


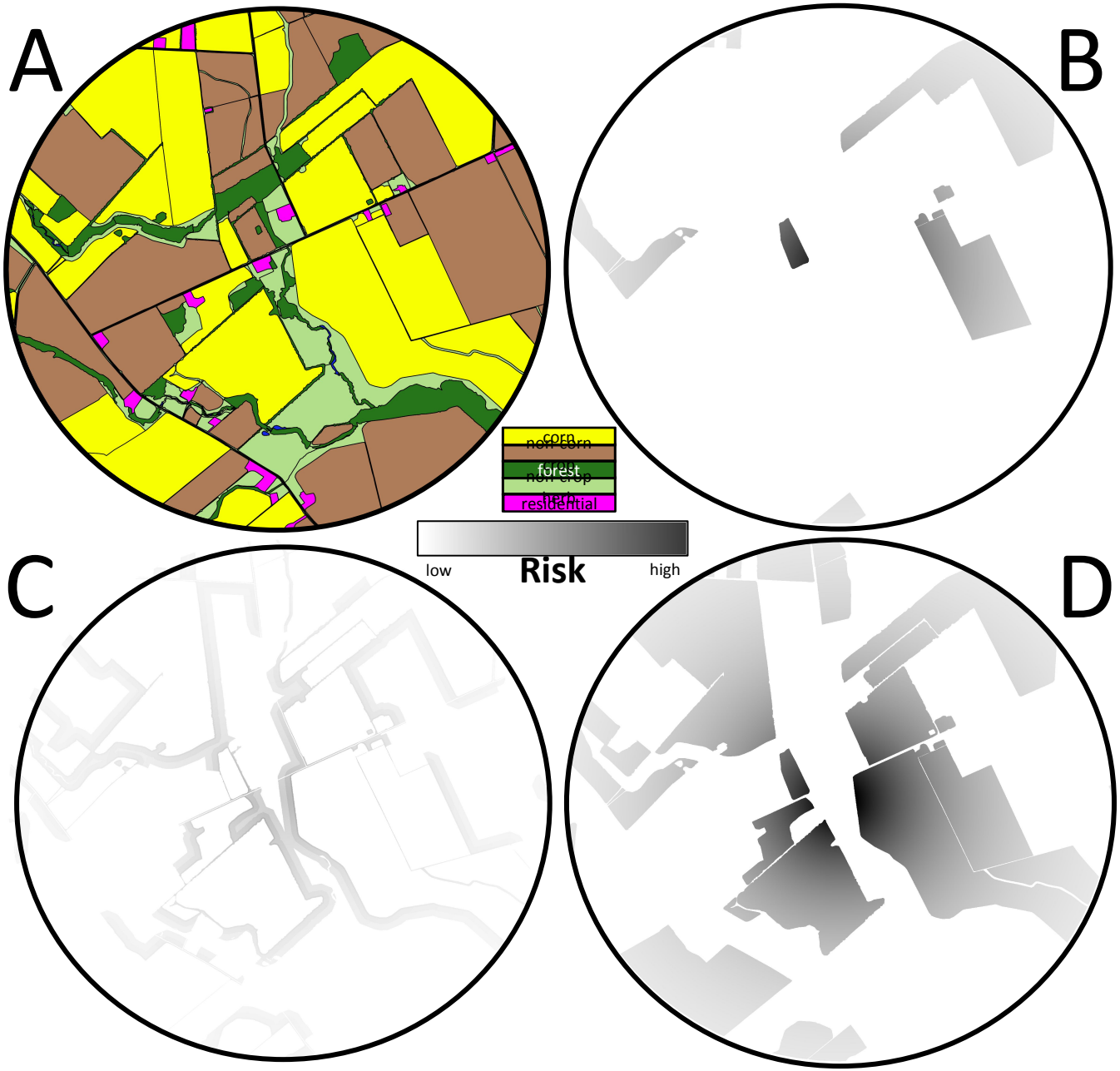
Measured in-field bloom levels

Interpreted waggle dances



Distance bees are foraging during corn planting




A
B
C
D
corn
non corn
forest
non crop
residential
low
Risk
high

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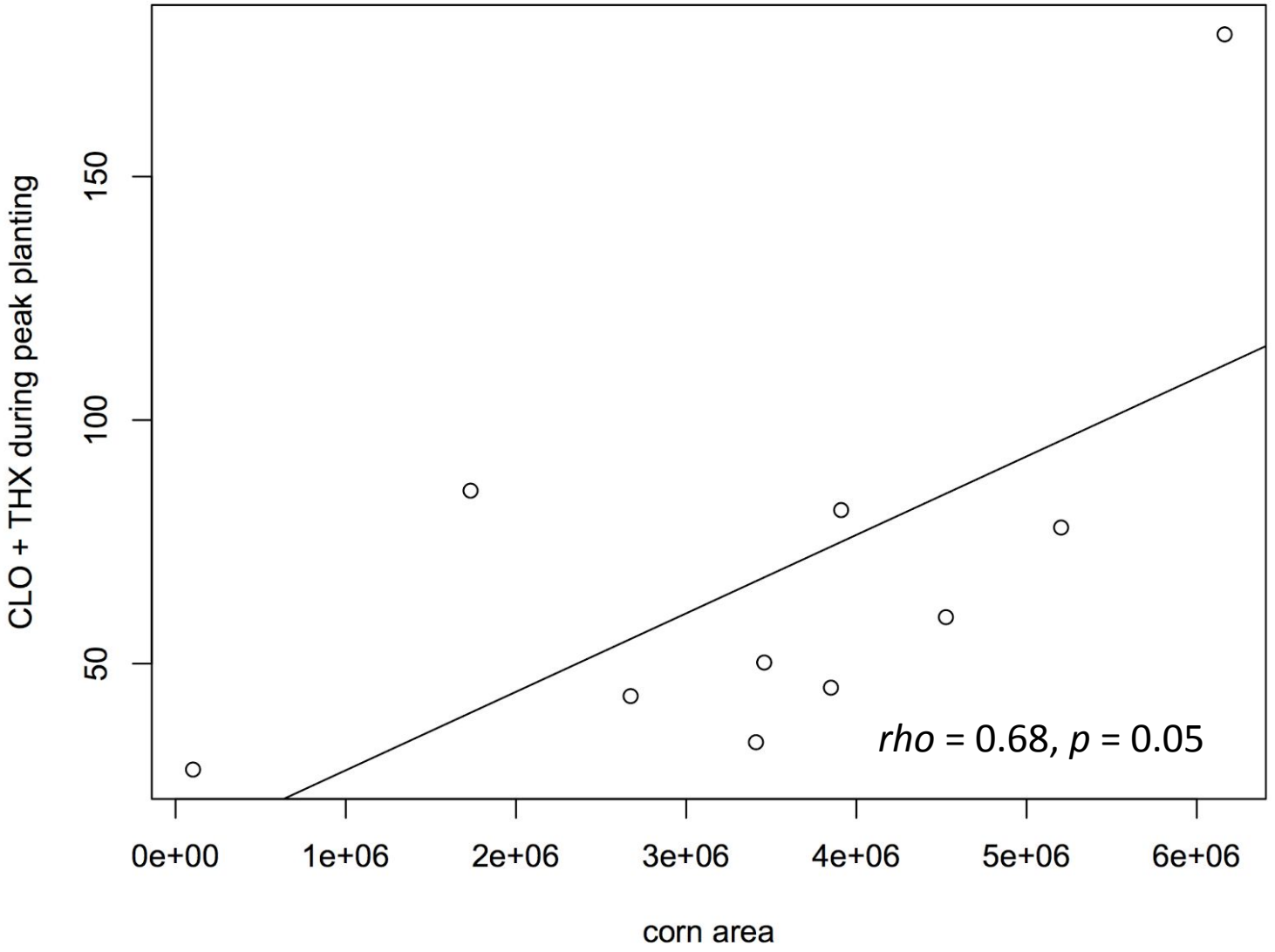
Corn Area Predicts Exposure



Hive monitoring and maintenance

Detailed inspections

- pre-planting (April 27-30)
- post-planting I (May 20-22)
- post-planting II (June 19 - 24)
- post-planting III (August 14 - 22)

Honey harvest:

- June/September

Mite treatment:

- Apivar: before experiment
- Formic acid: June, September
- Oxalic acid: November - December

Feeding (as needed):

- November - February

Overwintering Survival

- March 2016

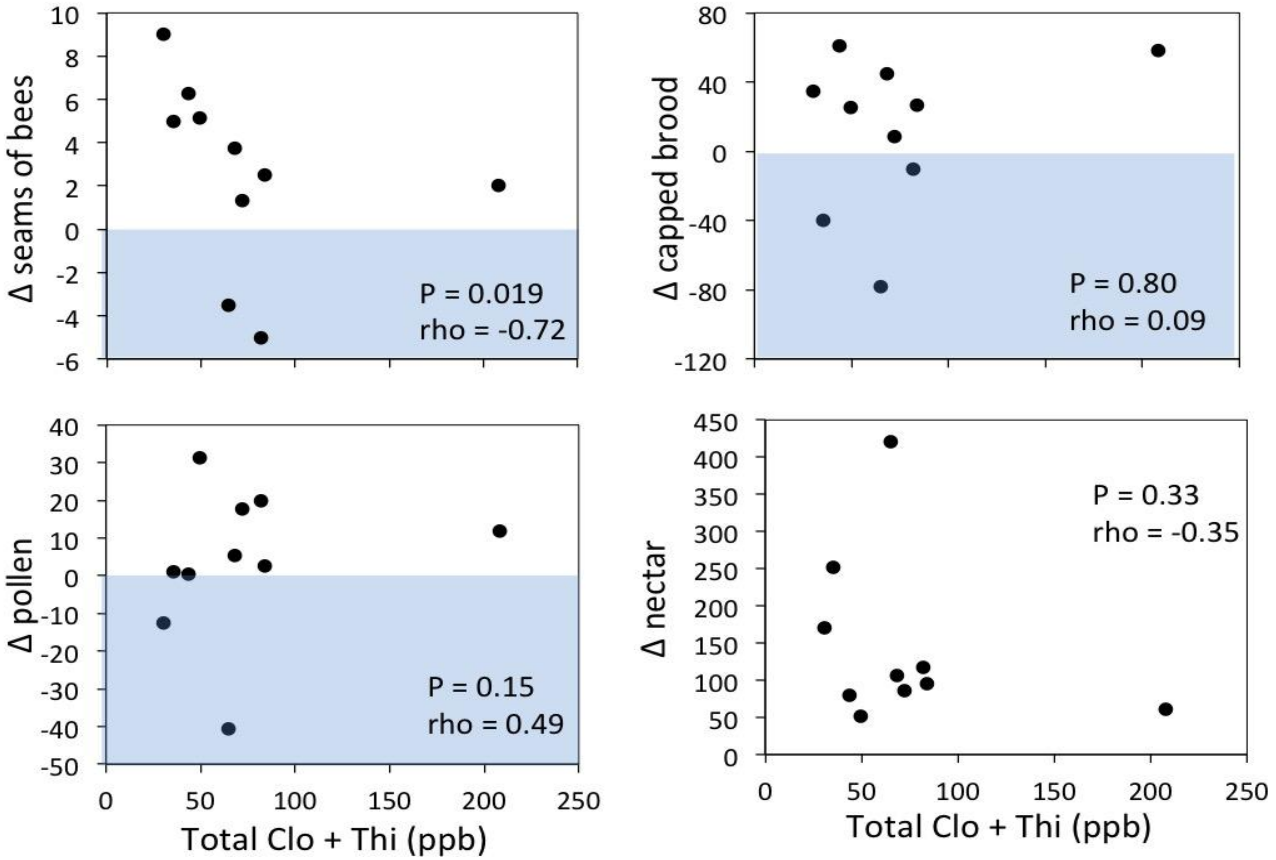
Quantifying hive parameters

"Box crack" inspections:
- seams of bees
- mite count

Frame area inspections:
- bees
- capped brood
- open brood
- honey
- pollen
- empty drawn comb
- undrawn foundation
- drone brood
- queen cells

Long-term effects . . .

- April – May: Negative correlation between insecticide exposure and change in the number of bees
- No correlation between exposure and other measures



Long-term effects . . .

- May – June: No significant correlation between insecticide exposure and any measure
- June – August: Increased pollen/nectar stores with more corn field (pollen: rho = 0.78, P = 0.008; nectar: rho = 0.71, P = 0.022)
- 31 of 34 colonies survived winter with no significant correlation between survival and insecticide concentration or corn area

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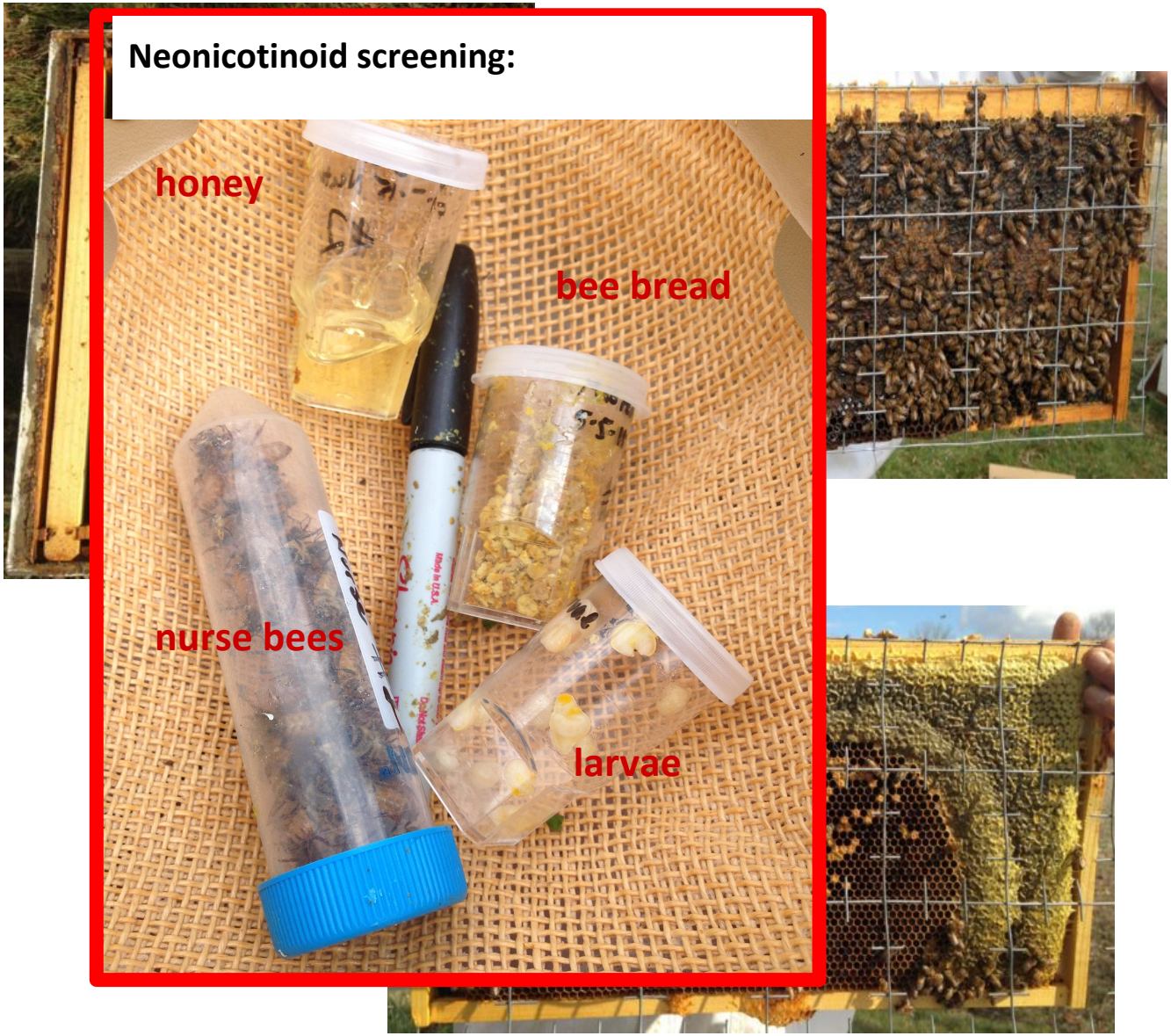
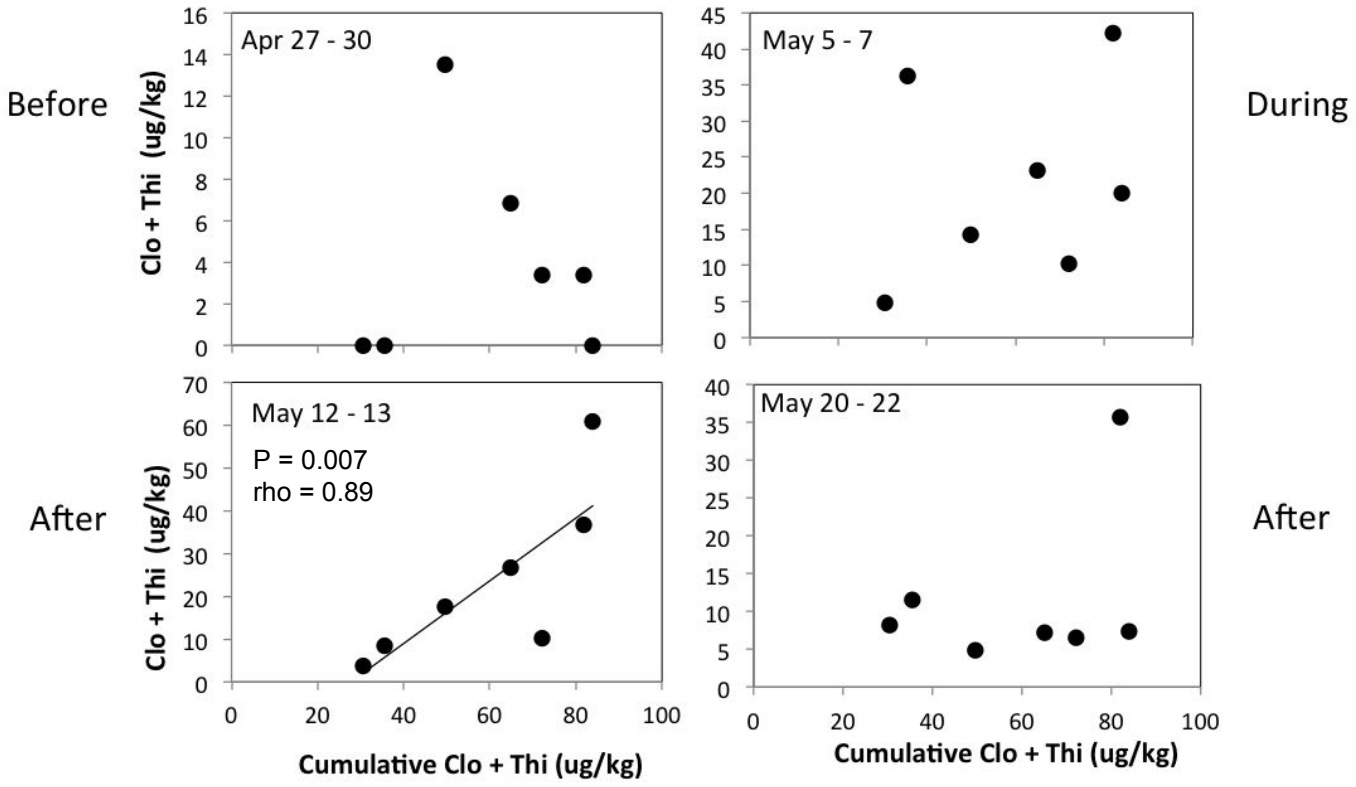


In-hive samples: bee bread

- Positive correlation between concentrations in pollen collected during planting and in bee bread sampled immediately after planting.



Conclusions

- Increased appearance of dead bees is correlated with corn planting and elevated seed treatment exposure through pollen (**but dead bee contamination is not**)
- **Bee bread contamination immediately after planting is correlated with pollen contamination during planting**
- **Correlation between reduction in adult population and pollen contamination** -- but no long-term effects

bold = changed with May 2017 concentration data

Conclusions

- **No correlation between pollen contamination and landscape**
  - **May not be possible to mitigate through simple recommendations to either farmers or beekeepers**
- More agricultural areas are better for honey production in over the summer
- Focus should be on reducing emission of insecticide through improved seed treatment quality or removal of insecticide

bold = changed with May 2017 concentration data

Acknowledgements

Doug Sponsler, Rodney Richardson, Michael Wransky, Juan Pillajo, Fariba Kanga, Natalia Riusech, Chia Lin

POLLINATOR PARTNERSHIP

USEPA

RARE

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